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AGRICULTURAL SEEDS AND THEIR IMPROVEMENT.

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AGRICULTURAL SEEDS AND THEIR IMPROVEMENT.

The following notes are published in order to indicate to the agricultural community the experimental work now on hand in the Agricultural Department as far as seed improvement is concerned, and also to suggest measures which can be adopted by planters on their own estates as a subsidiary contribution to the desired end.

TOBACCO.

A small quantity of very select seed of "Gold Leaf" and "Warne" varieties, obtained from the Tobacco Division of the United States Department of Agriculture in 1921, has been planted on the Government Farm, Namiwawa, as well as on estates in the Mikalongwe, Cholo and Blantyre areas respectively. In spite of a relatively unfavourable season the plants generally show a superiority to those grown from seed of the same varieties obtained from other sources. A number of plants of each variety are therefore being bagged for further trial in which the seed from each plant will be utilised to plant up a separate plot, and such plots as prove uniform in character will have all plants bagged in order to furnish a large supply of pure seed for sale.

Special plants of other varieties are also being selected and bagged on various estates, and the subsequent treatment will be as noted in the preceding paragraph. Whilst selections are being made on various estates, the trial plots will be mainly on the Government Farm, it being impossible to carry on such work in a number of districts owing to the amount of time and care necessary to ensure that the progeny of each plant is kept separate right through. It is essentially work in which one person must exercise personal supervision, and it cannot with safety be jointly carried out by a number of individuals.

It is anticipated that there will be in each year a large number of seed trial plots on the Government Farm, each plot from a single plant carefully selected wherever it appears desirable. Even though only three or four of these plots prove sufficiently uniform and desirable in each year, their plants when bagged will furnish a supply of pure seed sufficient for three or four estates, and it will be advisable for the estates receiving such seed to harvest a bulk in the following year sufficient to supply the requirements of a number of adjacent estates.

COTTON.

A number of selections, carefully made in 1921 by Mr H. C. Sampson, C.I.E., the cotton expert sent out by the Empire Cotton Growing Committee, are being grown on the Government Farm, Namiwawa; near Mpimbi; and at Chikwawa respectively. These places are fairly characteristic of the climatic zones from which the selections were made, and it is considered advisable to develop cotton selection work in future having regard to the requirements of three areas, roughly described as Lower River, Upper River—Lake Nyasa, and Highlands. A separate line is devoted to the seed from each selected plant, and the progeny of best lines will again be kept separate to plant larger plots.

In addition to the selections made by Mr Sampson, a number of choice new varieties were imported from the United States, the varieties "Pima," "Meade," "Acala," "Durango," "Columbia," and "Lone Star," being supplied by the Department of Agriculture, whilst from the Coker Pedigree Seed Co., the varieties "Webber Deltatype," "Webber 49," "Hartsville," and "Lightning Express," were obtained. All these varieties are being tried at the Government Farm, whilst a portion of the most likely varieties are also being tested at the medium and low levels. Only small quantities of seed were procured, and should any of the varieties prove satisfactory for any of our cotton districts, several years must necessarily pass ere they are sufficiently acclimatised and increased to permit of their issue to the community.

MAIZE.

At present selections growing on the Government Farm are from the "Hickory King" variety, which it is hoped to improve by fixing a better yielding strain, with cobs set low on the stems The cultivation of maize should merit more attention when export facilities are improved, and it will be necessary to import other varieties for trial in certain districts. A small plot of "Salisbury White" is being tried on the Government Farm. Care will be necessary in introducing new varieties, as should an export trade be feasible, it will be preferable to fix on one variety which shall be moderately adaptable to a wide range of estates, in order to ensure a uniform Nyasaland type, rather than to have several localised varieties, owing to great risks of crossing in this naturally cross pollinated crop. If an export trade is not feasible a uniform type is unimportant, and localised types, solely characterised by a high yielding capacity coupled with weevil-resistant properties, will be the desired end.

Preliminary tests are also being made with wheat and rice varieties, and as much attention as possible will be given to these crops. There is no reason why sufficient wheat should not be grown in Angoniland alone to supply the needs of Nyasaland, whilst an improved production of rice, alike as to quantity and uniformity of quality, is eminently desirable now that a railway to the Lake is seriously contemplated.

The work already in hand as outlined above will be continued and extended as far as possible, but time must necessarily elapse before marked results can be expected, and planters are strongly advised in the meantime to adopt some seed selection on their own estates. The following paragraphs outline the methods which should be adopted with respect to our main crops, viz., tobacco and cotton, and though these methods cannot be expected to fix new types, they will, if persevered in, give practical results of considerable value.

TOBACCO.—SEED SELECTION.

According to the amount of seed required, select an area of one or more acres of good average tobacco, preferably from a medium to late season, rather than from a very early season's planting. Give the plants normal cultivation, prime them uniformly high and early, and uproot any showing traces of disease.

Do not top any plants, but allow the flower heads to develop until a distinct colour is noticeable in the earliest buds (usually four or five days before they actually open), when the leaves below the flower head should be stripped down to such point as will leave on the plant the normal number of leaves for the variety, estate, season, and type of leaf grown. Treat each plant uniformly when, and not until, it reaches the proper stage for stripping the top leaves.

Suckering should be attended to, and when a few flowers have expanded, commence to select the seed-bearing plants. Decide on the most important character it is desired to accentuate—it may be tallness or dwarfness, broad leaf or long narrow leaf, or otherwise. Select for the one desired character, and immediately top all plants which do not confirm to this ideal. Then go over the selected plants again, and re-select for a secondary characteristic, again topping those which are deficient, and repeat the process for other characteristics if desired. Eventually a small number of remarkably uniform plants will be left with seed heads, whereas such uniformity is not easily attained when the average individual tries to make a direct selection, having several desired characteristics in view.

Any flowers which have opened, or young capsules, should be removed, as there is a possibility of their having been pollinated with pollen from the discarded plants. The selected seed heads should then be bagged to preclude further cross pollination, even from apparently identical plants. The best bags are made of light but tough manila paper. Opaque paper or glazed paper must be avoided, as the flower buds are liable to rot. Calico or linen bags are quite effective but are very tempting to the average native. Comparative protection from cross pollination can be secured by folding one thickness of newspaper round the head, pinning it below, though, owing to showers, it may tear and require replacement once or twice.

Whatever kind of bag is used it should be removed once a week to shake out decayed flowers, remove sucker shoots, and to search for a bud caterpillar which is partial to the young seeds. After four weeks the bags may be removed entirely, and at same time all unopened flower buds and flowers should be removed. Suckers should be removed from the seed bearing plants, and the leaves retained when stripping from the flower head downwards should be allowed to remain on the plants, and should not be removed for curing under any circumstances.

When two-thirds of the seed capsules turn brown the head should be cut and hung up in a cool airy shed. The capsules when thoroughly dry should be crushed and sifted to remove the seed. The seed should then be dropped gently through a steady current of air which should be sufficiently strong to remove from one quarter to one third of the smaller and lighter seed, the sound seed being then placed in perfectly dry bottles, and stored in a dark but dry and airy cupboard.

Sufficient seed should be harvested so that not more than one-fourth will be required in the first year, when, if satisfactory results are obtained, as should be the case, there will be enough seed left on hand to plant another two or there crops, as *properly* stored tobacco seed retains its vitality for at least seven years.

COTTON.—SEED SELECTION.

Cotton seed can be much improved on the average farm by resorting to a judicious use of mass selection, special emphasis being laid on the word judicious, for there is no more potent means of ruining a fair cotton than by resorting to mass selection on wrong lines. Apart altogether from a tendency in cotton to vary and revert to more primitive type there is usually about five per cent. of cross pollination by insects in this nominally self pollinated crop. A strain once purified will breed fairly true for a year or so, but with the inevitable small percentage of cross pollination the hybrid population becomes more pronounced and diverse year by year. Hybrids in cotton and many other plants are generally much more vigorous than their pure-bred parents. When the average individual goes through a crop to make some mass selections, he almost invariably chooses the most vigorous plants regardless of other characters, and mixes them for a special seed plot, and so selects the hybrids and mongrels, which on development are even more diverse, though no doubt very vigorous. In line breeding where the progeny of each plant is raised separately the hybrid character is more easily detected, owing to diversity of plant type, and can be discarded.

If, therefore, it is decided to resort to mass selection in order to establish a special seed plot, careful attention should be directed to the following points :—

Conduct the selection just as a field is ready for its first picking. Examine the plants one by one over a large area, and ignore all that are exceptionally vigorous and well grown as being probably hybrids, and aim at medium grown plants only, allowance being made for soil variations throughout the field.

Aim at securing plants with all branches disposed horizontally, or even dropping with weight of bolls, and ignore plants which have one or more almost vertical branches commencing near the base. If the crop has not been topped, select plants with a distinctly conical outline and avoid cylindrical or flat-topped specimens. Choose plants with relatively short intervals between the branches on main stem, and between the leaves on the side branches, and having bolls developed from close to main stem and outward in succession.

The vegetative characters outlined above being satisfactory, concentrate on plants with a large proportion of bolls ripened at one time. Pull a tuft of lint from three or four bolls on each plant, to estimate length and strength of fibre. Ignore any specially long or short linted plants, and all with the least trace of weakness. Strength is more important than length but uniformity is more important still.

Attention to the degree of hairiness of the leaves will assist in determining the relative purity of the stock, as whilst the general tendency is for plants to vary in the direction of more hairy leaves in a dry hot climate, and toward a smoother type in a moist climate, a wide range under any given set of conditions can be considered as due to unstable or mixed type of cotton. Some investigators claim that important lint characteristics are associated with varying degrees of hairiness. Watt in his "Wild and Cultivated Cottons" frequently refers to this, and states that in American-derived varietes the tendency is toward the association of smoother leaves with long silky readily separable lint, whilst in India the tendency is for the more hairy leaf to be associated with longer lint.

"Twist" is another important characteristic on which much emphasis is placed, especially by spinners, but it scarcely comes within the sphere of a planter aiming at mass selection or purification by rogueing. In one set of environmental conditions the seed hairs make little or no secondary thickening, the fibres consequently become very flat and thin, lie parallel, are very silky, and are unable to exert a powerful twist on drying. At the other extreme which may occur in bolls on the same plant, excessive secondary deposits on the inner wall of the hair result in its becoming a relatively solid body instead of a tube, and therefore incapable of collapse and twist on drying. At some intermediate point when conditions have been more ideal the maximum amount of twist will be found to take place. Extreme twist is relatively more important in the short than in long stapled cottons. The environmental factor is primarily important in securing twist, though doubtless there is also a distinct hereditary phase in the development of this character.

When the desired number of plants have been selected and marked with a label or bamboo, go through with a trustworthy native and see that all opened cotton from the marked plants only is collected into a special bag before the general picking commences, afterwards removing the marks from the plants, so that any subsequently ripened cotton may be harvested with the common lot.

The selected seed cotton should be ginned by hand or in a small hand gin to avoid mixing. It is desirable to plant a large area with the seed therefore not more than two, and preferably one seed should be planted at each hill. As many soils form a very hard surface crust after rain it is customary to plant 6 to 12 seeds at each hill, the combined efforts of these germinating seeds usually sufficing to fracture the crust where one seed would fail to do so. If, however, the single seed is dibbled into a hole about 1½ inches deep, and covered with clean sharp sand or fine gravel instead of soil, practically every seed will germinate and grow freely, as in addition to lack of competition from adjacent seedlings, its rootlets do not become broken as is the case in thinning out ordinarily sown cotton.

An alternative to the mass selection outlined is worthy of attention, as whilst it may not achieve as much as skilled mass selection it is free from the dangers attendant thereon. This is by adopting a purification or rogueing scheme.

Select from one to ten acres of good average cotton, and go carefully through it just before the first flowers open. Examine each plant and uproot all which are exceptionally vigorous as being probably hybrids, and any which do not possess the branching characteristics mentioned as desirable in previous paragraphs. Any plants which show a sparse development of flower buds may also be uprooted.

Another careful inspection should be made just prior to the first picking, and on this occasion all plants which are unproductive compared with the average, as well as those which are distinctly late in ripening should be uprooted. If desired, a further examination of each plant may be made in order to eliminate any which bear unduly short or weak staple, after which one picking only should be made to supply the mass of seed for the special seed plot, any later ripening cotton going into the general crop. The selected seed cotton should be treated as suggested for that obtained in "mass selection."

The subsequent paragraphs deal with some general principles rather than with the practical aspect which has been emphasised in the earlier portion of the bulletin.

Better crops, as far as the influence of the seed is concerned, can be obtained by:—

(*a*) Introduction of new species or varieties from other countries.

(*b*) Breeding and selecting improved types from those already grown in the country.

It is advisable to take advantage of the existence in other countries of crops hitherto untried, as well as highly bred varieties of crops now being grown in the Protectorate. The proportion of successful new introductions is, however, usually very low, and this is not surprising when consideration is given to the extraordinarily diverse plant environments caused by the endless permutations and combinations of such factors as altitude, latitude, temperature, light, winds, rainfall and soils, and the incidence of noxious biological factors, particularly bacteria, fungi and insects. In the case of highly specialised crops the choice varieties have been carefully bred and selected for a most precise environment, and are liable to be failures even when grown within a few miles of the place in which and for which they were evolved.

Some newly-introduced plants are condemned after one trial only, owing to indifference or ignorance concerning possibilities of acclimatisation, or to a specially unfavourable season having occurred, whereas patient observation of the new variety for a few years might have revealed a plasticity of which advantage could have been taken, converting the "failure" into a partial or complete success.

The State should discourage the promiscuous introduction of plants and seeds for various reasons, including financial loss, and waste of time due to low percentage of successes, and overlapping through ignorance of what has already been tried and proved utterly useless. The great danger is, however, that actual harm may be done, either through the contamination of existing varieties as a result of unintentional cross pollination, or by the accidental introduction of virulent diseases or insect pests. When the State controls all introductions it enhances the general security, as in addition to knowledge of what particular introductions or from what particular countries introductions should be avoided, it is able to secure the co-operation of the Departmental officials in the exporting States, and these officers can ensure the maximum degree of safety by their rigorous examination and treatment of seeds, etc., before despatch.

Whilst good has been done in the past in various countries through the uncontrolled introduction of new seeds, plants and animals, there is also a history of disastrous results, either through the actual introduction becoming a nuisance, as for instance rabbits in Australia and sparrows in many countries, or through the introductions conveying weeds, insects or fungi, the result being thistles in Canada, and pink boll-worm in Egypt and the United States, to quote two instances only.

The ideal to which strict plant breeding is directed is to improve the quality, yield and uniformity of the particular crop. Whilst these three desiderate can be more nearly attained by the use of pure bred seed, pure bred seed will not achieve everything, and when the treatment it receives on a farm is characterised by the maximum degree of ignorance or inertia the results are bound to be unsatisfactory.

Varieties are obtained by preserving variations, and are preserved by destroying variations.

In breeding up a stock of seed from selected individuals, results are relatively slow, but development is positive. The actual rate of development depends partly on the reproductive capacity of the crop being worked on, and partly on the genetic purity or impurity of the individual plant selected, this being only revealed when its offspring are carefully examined. Owing to the mixed character of the population in most economic crops, numerous disappointments must be expected in practice, quite apart from ravages of insects or disease, or unfavourable seasons, as even when it is possible to prevent cross pollination, e.g., in cotton or tobacco, the selected plant may prove on propagation to have been already of hybrid origin, and further trial becomes necessary before it is possible to say whether any of the subsequent progeny will breed true to desired characters.

Strict plant breeding is therefore distinctly expensive, entailing the utilisation of much time and steady perseverance, and, being beyond the ability, means or opportunity of the average planter, is a service to be undertaken by the State on behalf of its members. The ideal aim of the Department in this connection should be to select plants in various parts of the Protectorate, from acclimatised as well as from newly introduced varieties which show decided merit, and when these breed true, stocks should be multiplied to a moderate degree only. Instead of indiscriminate distribution in small quantities it is preferable to issue to one planter enough pure seed to plant his normal acreage, on the understanding that he takes precautions to keep the resultant seed pure as possible for further distribution to his neighbours, at a reasonable charge.

There should thus eventuate a yearly output of pure, and possibly still further improved, seed from the Department, and this in turn should be maintained by planters in a good condition for some years by attention to the practical suggestions already detailed.

Attention may be drawn to a common fallacy that a "change of seed" is good, referring more particularly to the introduction of the variety regularly grown from another source in preference to utilising home grown seed. Other things being equal the longer a type has been acclimatised the more suitable it is for a given locality. Apparent advantages are obtained from the change at times. In certain years cotton seed will be well developed in the Highlands, but small and shrivelled on the Lower River, whilst in other years the conditions may be reversed. As sound seed gives better germination and quicker growth than stunted seed, it is possible to transfer seed from high level to low in one year, and get improved results, whilst in another year the change will prove to be useless, better results being obtained by transferring seed from the Lower River to the Highlands—in other words the "change" is unimportant but sound seed is essential.

The following pertinent paragraph is from Percival's "Agricultural Botany":—

"Very few if any varieties of plants propagated by seeds remain like the type first sent out by the raiser for more than a limited number of years. In a great many instances where almost everybody raises seed, destruction of "rogues" is not efficiently or thoroughly carried out, and, through the consequent mixing with the progeny of the reverted plants, the type rapidly degenerates in purity. Apart from the incompetence to distinguish slightly reverted forms and laziness in carrying out their destruction, other changes take place in the type through the different ideal which each raiser of seed sets up in his mind when he selects the individuals to be employed as seed parents. For example three different raisers of seed of Gubbins "Incomparable" "pea" are almost certain to hold different views from Mr. Gubbins and from each other in regard to the relative importance of the various characters of a good pea. Selection is therefore carried out from three different standpoints, and in a few generations the "Incomparable" variety no longer exists except in name, unless Mr. Gubbins himself also carries on the propagation—three different types bearing the same name would arise. It is therefore very necessary for the farmer and gardener not to be led away by the fascination of an old name, for it does not follow that anything useful is obtained with it. At the same time it must be remarked that a new name does not necessarily represent any new quality or character in the seeds to which it is applied, as new names may easily be applied to old articles when the latter cannot be sold by their original names."

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